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Early-life adversity, later-life mental health, and resilience resources:

A longitudinal population-based birth cohort analysis

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Abstract

Background: Robust and persistent links between early-life adversities and later-life mental distress have previously been observed. Individual and social resources are associated with greater mental health and resilience. This study aimed to test these resources as moderators and mediators of the association between childhood psychosocial adversity and later-life mental distress.

Methods: Participant data came from the Medical Research Council National Survey of Health and Development, a nationally-representative birth cohort study. The General Health Questionnaire-28 (GHQ-28) captured mental distress at ages 53,60-64, and 68-69. An eight-item cumulative psychosocial adversity score was created (0,1,2,≥3 adversities). Individual (i.e. education, occupational status, physical activity) and social (i.e. social support, neighbourhood cohesion) resources were examined as mediators and moderators of CPA and GHQ-28 in longitudinal multilevel models.

Findings: Greater adversity was associated with an average GHQ-28 score increase of 0.017, per unit adversity (β=0·017, p<0·001, 95% CI 0·011, 0·022). Lower mental distress was associated with higher levels of physical activity, occupational status, education, social support, and neighbourhood cohesion. There was no evidence that resources moderated the relationship between GHQ-28 and adversity. All resources, save for physical activity and occupational status, partly mediated this relationship.

Conclusions: Individual and social resources were associated with lower mental distress. They did not modify, but partly mediated the association between childhood adversity and adult mental distress. Social support was the most important mediator, suggesting that interventions to promote greater social support may offset psychosocial adversities experienced in childhood to foster better mental health in older adults.

INTRODUCTION

The implications of early-life experiences for later-life health and wellbeing are numerous and varied (Kuh *et al.*, 2014). Children who are exposed to adversities, such as maltreatment, are at an increased risk of poor mental and physical health outcomes later in life, when compared to children who have experienced fewer adversities(Kuh *et al.*, 2014; Rodgers, 1996b). Psychiatric disorders, in particular, have been shown to have robust links to childhood psychosocial adversities in large-scale community-based studies(Green *et al.*, 2010; Kessler *et al.*, 1997). Further, these links have been shown to persist across the life course into later-life(Comijs *et al.*, 2007).

Children may experience a range of psychosocial adversities in a variety of combinations. Consequently, the operationalisation and quantification of adversity has varied in the literature. Given that childhood adversities are unlikely to occur in isolation, a cumulative approach permits the capture of multiple adversities, covering a greater breadth of these experiences. These have demonstrated an association between greater psychosocial adversity and greater affective symptomology in later-life (Heinonen *et al.*, 2018; Rodgers, 1990).

A number of individual and social resources are related to better mental health and low levels of these resources may contribute to explaining the association between multiple childhood psychosocial adversity and poorer mental health in later life. In accordance with Rutter's chains of risk model (1987) childhood psychosocial adversity is associated with poorer cognition,(Hatch *et al.*, 2007) poorer self-organisation, (Cicchetti and Rogosch, 1997) lower educational attainment,(Veldman *et al.*, 2015) disadvantaged socioeconomic position in adulthood and other risk factors for poor adult mental health including physical inactivity(Kestila *et al.*, 2015) and poor quality support from family, friends and the local community (Ford *et al.*, 2011).

Despite strong links between early-life negative events and later-life negative mental health outcomes, the heterogeneity of responses to adversity means that some individuals do not experience these outcomes, suggesting mental health resilience (Rutter, 2000). "Resource", "asset", or "reserve" hypotheses posit that the heterogeneity of responses to adversity is due to factors that buffer or ameliorate negative outcomes. Perceptions of social support have been shown to moderate the mental health outcomes resulting from stressors by encouraging positive psychological dispositions and promoting coping strategies (Thoits, 1995) whereas deficits in these resources may exacerbate the mental health effects of later stressors (Pearlin *et al.*, 1981).

Although the relationship between greater childhood psychosocial adversity and poorer mental health outcomes is well documented, (Green *et al.*, 2010; Kessler *et al.*, 1997) fewer investigations into resources that moderate or mediate this relationship have been conducted in this context. Moderation studies aim to identify whether an interaction between resources and early-life adversity is associated with lower risk of later-life mental health, whereas mediation studies aim to examine the generative mechanisms through which social and individual resources act along the causal pathway between early-life adversity and later-life mental health (Baron and Kenny, 1986). Using these strategies it is possible to identify groups that are particularly at risk and/or whether some of the variance in the exposure-outcome relationship is explained by variation in resources. These studies have revealed mixed results (Hill *et al.*, 2010). In an examination of social support in the 1958 British Birth Cohort, Ford, et al. (Ford *et al.*, 2011) found no mediation of childhood psychosocial adversity and mid-life affective disorders by social support. In a population-based Japanese cohort, socioeconomic status and social support were both observed to partly mediate the childhood psychosocial adversity and adult mental health (Oshio *et al.*, 2013).Neither of these studies found evidence that individual or social resources had a moderating effect, though there is support from elsewhere that social support buffers (weakens) the association between childhood psychosocial adversities and poor adult mental health (Hill *et al.*, 2010; Logan-Greene *et al.*, 2014).

A notable limitation of previous studies assessing potential moderators and mediators of the association between childhood adversity and later mental health is the examination of mental health at a single point in time; longitudinal studies are able to collect richer data. The present study aims to examine the relationship between multiple childhood psychosocial adversities and later-life mental health captured on multiple occasions. It uses prospective data on childhood adversities from the MRC National Survey of Health and Development, the oldest of the British birth cohort studies, with follow-up into the seventh decade. Informed by previous work on cumulative adversities within this cohort (Caleyachetty *et al.*, 2018), we investigated the impact of multiple psychosocial adversities in childhood on mental health outcomes in later life, and the individual and social resources that moderate and mediate this association. The aim of the moderation analysis was to establish whether resources altered (or modified) the strength of the relationship between early-life adversity and later-life mental distress. The aim of the mediation analysis was to provide insight into whether resources existed along the causal pathway from early childhood adversity to later-life mental distress. In line with previous

studies, we hypothesise that greater adversity will be associated with greater mental distress (Green *et al.*, 2010; Kessler *et al.*, 1997). We hypothesise there will be a weaker association between adversity and greater mental distress among those with greater individual and social resources (i.e. individual and social resources will modify the relationship). In the absence of moderation, we hypothesise that individual and social resources will partly explain, i.e. mediate, the relationship, between childhood adversities and later-life mental health.

METHODS

Sample

The Medical Research Council National Survey of Health and Development (NSHD) is a sample originally consisting of 5,362 social class-stratified singleton births in mainland Britain in one week during March 1946(Wadsworth *et al.*, 2006). At age 68, of the 2816 people in the target sample living in England, Scotland and Wales, 2370(84.2%) completed a postal questionnaire. Of those not in the target sample, 957(17.8%) had already died, 620(11.6%) had previously withdrawn from the study, 574(11.0%) lived abroad, and 395(7.4%) had been untraceable for more than five years. At age 69, study members found to be still living in Great Britain at the last known address or traced to a new address (n=2698) were invited to have a home visit by a research nurse: 2149(79.7%) completed a visit and a further 55(2.0%) completed a brief postal questionnaire instead. In total, 2638 study members (93.7%) provided information on the postal questionnaire and/or completed a home visit.(Kuh *et al.*, 2016) Ethical approval for this data collection was obtained from the NRES Queen Square REC (14/LO/1073) and the Scotland A REC (14/SS/1009).

Early Childhood Psychosocial Adversities

Eight childhood psychosocial adversities were examined: five were measured prospectively at age 0-16, three measures were retrospectively captured (recalling experiences from ages 0-16) at age 43 (Caleyachetty *et al.*, 2018). These psychosocial adversities consisted of: maltreatment, low parental concern for child's education, parental psychiatric history, parental divorce, affectionless control (from mother and from father), parental death, and maternal separation (Table 1). The presence(1) or absence(0) of these adversities was summed and grouped into 0 adversities, 1 adversity, 2 adversities, or 3 or more adversities, to create a cumulative psychosocial childhood adversity score, as previously published (Caleyachetty *et al.*, 2018)

Mental Health

Mental health was assessed using the General Health Questionnaire(GHQ-28), a self-reported measure of anxiety and depression symptoms, at ages 53, 60-64 and 68-69 (Goldberg and Hillier, 1979). Each of the 28 items is scored on a 4-point Likert scale (scored from 0 "low distress" to 3 "high distress"), asking

participants if they had experienced mental distress, e.g. worry, loss of sleep, in the past four weeks. Responses were log transformed to improve the normality of the distribution.

Individual Resources

Socioeconomic Position

Occupation-based social position was coded using the UK Registrar General's Social Class scheme into six categories: professional, managerial, technical/skilled non-manual occupations, skilled manual, partly skilled and unskilled. Data for adult head of household social class were collected from the participant at age 53(or age 43 if missing at 53 (n=85) and 36 if missing at 53 and 43(n=16)). We did not use occupation data above age 53 because changes around retirement may not accurately capture socioeconomic position. Educational attainment by age 26 was categorised as "No education or Sub-GCE", "O-Level or equivalent" (typically obtained at age 16) "A-Level or equivalent" (typically obtained at age 18), and "Degree or higher".

Leisure Time Physical Activity

At ages 53, 60-64, 68-69, study members self-reported the number of times they had participated in any sports, vigorous leisure activities or exercises in their spare time, not including getting to and from work, in the past 4 weeks coded as : 0 times(coded 0), 1-4 times(1), or 5 or more times(2).

Social Resources

Social Support

At ages 53, 60-64, and 68-69 participants reported on six items relating to positive and negative support from the person they felt closest to in the last 12 months: how much they confided in the person; how much talking to the person made them feel good about themself; how much they shared interests, hobbies; how much they would have liked to have confided more; how much the closest person gave them worry, problems and stress; how much talking to the person made things worse; (Supplementary Table 1). Response options ranged from "not at all" to "a great deal" and these were reverse coded where appropriate, then summed and standardised at age each age to create a cumulative social support score with higher values indicating higher levels of support.

Neighbourhood Cohesion

At age 60-64, participants were asked how strongly they agreed with a series of statements regarding their neighbourhood: "I feel like I belong to this neighbourhood", "The friendships and associations I have with other people in my neighbourhood mean a lot to me."; "If I needed some advice about something I could go to someone in my neighbourhood."; "I would be willing to work together with others on something to improve my neighbourhood."; "I plan to remain a resident of this neighbourhood for a number of years."; "I like to

think of myself as similar to the people who live in this neighbourhood."; "I regularly stop and talk with people in my neighbourhood." ". Likert responses ranging from "Strongly Agree"(5) to "Strongly Disagree"(1) were summed to create a cumulative score ranging from 14(lowest cohesion) to 35(highest cohesion) and standardised for analysis (Cronbach's alpha = 0.86). These items were not available at other ages.

Statistical Analysis

To examine the association between childhood psychosocial adversities and mental distress at ages 53, 60-64 and 68-69, multilevel linear regression was used. This accounts for the possible non-independence of repeat observations on each study member. Log-transformed GHQ-28 scores at ages 53, 60-64, and 68-69 were regressed on psychosocial adversity score from 0 to 3 in a sex-adjusted random intercepts multilevel model with measurement occasion (level 1) nested within individual study members (level 2). Using the likelihood ratio test, we confirmed a positive linear (rather than non-linear) association between greater childhood adversity and greater GHQ-28 scores. To test internal reliability, Cronbach's alpha was calculated for each of the three waves of GHQ-28 data collection (Tavakol and Dennick, 2011). Covariates that were captured in adulthood on more than one occasion (physical activity and social support) were included as time-varying. Socioeconomic position and neighbourhood cohesion were assumed to be stable across the three occasions. In sensitivity analysis, we also examined the association between each childhood psychosocial adversity indicator and log GHQ-28 score.

To test moderation, interactions between psychosocial adversity score and each resource in turn were examined (Supplementary Figure 1). In preliminary models we tested for sex by adversity and sex by resource interactions but none were found so we present only sex-adjusted models here.

To examine mediation by resources (Supplementary Figure 2), we first examined associations between childhood psychosocial adversity score and each potential resource in turn using ordinal logistic, multinomial logistic, or linear regression models (Supplementary Figure 2: a). We then examined associations between each resource and log-transformed GHQ-28 scores (Supplementary Figure 2: b'). Finally, for resources that demonstrated relationships in the two aforementioned associations, we estimated the percentage change in the regression estimate for childhood psychosocial adversity in the null model (sex-adjusted only, model m0) and the model which additionally included the resource (models m1) (Supplementary Figure 2: c'). This quantified how much of this relationship was mediated or explained by the resource in question.(Baron and Kenny, 1986) In the final model (m2), we quantified how much of the relationship was mediated by all resources together.

Analytical sample

At ages 53, 60-64, and 68-69 participants provided a total of 7217 observed GHQ-28 scores. Of these, there were 4517 observations with complete data on

childhood psychosocial adversity and a further 2113 with at least four of the eight adversity items for which a total adversity score was imputed, yielding an analytical sample of 6630 observations based on 2785 participants. Missing data on resources were also imputed.

Missing data were handled via multiple imputation by chained equations with 30 complete datasets created (Kenward and Carpenter, 2009). The following auxiliary variables captured in childhood were included in the imputation part of the model: maternal education, father's social class, housing tenure, overcrowding, household amenities and repair of house and child's clothes and shoes. The imputation model included GHQ scores at ages 53-69 but those with unobserved GHQ scores were dropped from the analytical part of the modelling, as were those with three or more psychosocial adversity variables missing (Von Hippel, 2007). Previous analysis in NSHD did not identify a relationship between socioeconomic factors in childhood and later-life mental distress (Caleyachetty *et al.*, 2018); therefore, we did not include these as covariates in the estimation part of the models.

RESULTS

Sample

Sample characteristics are described in Table 2. Individuals missing from the analytical sample, i.e. did not have GHQ-28, were more likely to be male, were less physically active, had lower occupational status, were less educated, and lower neighbourhood cohesion (Supplementary Table 2).

Greater psychosocial adversity was linearly associated with higher log-transformed GHQ-28 scores(β=0.017 per unit adversity, $p<0.001$, 95% CI 0.011, 0.022) in a sex-adjusted model; participants with three or more adversities experienced 5.0% higher GHQ-28 scores compared to participants who experienced no adversities. Of the individual components of the childhood psychosocial adversity score, low parental concern for the child's education, parental divorce, mother affectionless control, father affectionless control, and maltreatment were associated with higher GHQ-28 scores(Supplementary Table 3). The GHQ-28 demonstrated good to excellent internal reliability at ages 53 (α=0.92), 60-64 (α =0.89), and 68-69 (α=0.92)(Tavakol and Dennick, 2011). Parental psychiatric history, parental death, and maternal separation were not statistically significantly associated with GHQ-28 scores but associations were in the expected direction.

Do individual and social resources modify the association between childhood adversity and adult mental distress?

There was no evidence of effect modification by individual or social resources. Terms representing the interaction between childhood psychosocial adversity score and each of the resources did not approach statistical significance ($p>0.15$ for all terms) (data available from the authors).

Do individual and social resources mediate the association between childhood adversity and adult mental distress?

The first step of the mediation analysis examined associations between childhood psychosocial adversity and each potential resource. Greater psychosocial adversity in childhood was associated with lower levels of occupational status, education, social support, and neighbourhood cohesion(Table 3).

In sex-adjusted models, higher levels of physical activity, occupational status, education, and social support were associated with lower levels of mental distress(Table 4). In a mutually-adjusted model, greater physical activity, and social support were associated with lower GHQ scores.

There was some attenuation(7.10%-12.31%) of the association between childhood psychosocial adversity and mental distress on adjustment for physical activity, occupational status, education (with each resource considered one at a time)(Table 5). The effect of social support was the greatest, explaining a quarter of the association between childhood psychosocial adversity and GHQ-28 scores. All resources save for physical activity and occupational status partly mediated childhood psychosocial adversity and GHQ-28 scores when exposures were considered singly (Table 5).Altogether, these resources explained almost 40% of the association between childhood adversity and mental distress.

DISCUSSION

Greater childhood psychosocial adversity was associated with greater later-life mental distress. Participants with greater levels of individual and social resources experienced better mental health. Education, social support and neighbourhood cohesion were associated with later life mental health and partly mediated its association with early-life adversity. Of the resources examined, social support explained the greatest proportion (25.3%) of the relationship between early-life adversity and later-life mental health, followed by neighbourhood cohesion (16.1%). Although no moderation of the associations between early psychosocial adversity and mental distress was observed, these resources partly mediated the relationship.

In line with previous research (Green *et al.*, 2010; Kessler *et al.*, 1997), greater levels of childhood adversity were associated with greater levels of mental distress. Through the use of a cumulative adversity score in childhood we were able to achieve a broader perspective on the levels of adversity experienced, rather than via a single adversity item. Previous studies examined mental distress on a single occasion in mid-adulthood or older age; the present study adds to this by considering mental distress collected at up to three occasions over a 15 year period.

We also sought to identify factors that were particularly protective in high risk groups by examining whether there was an interaction between psychosocial adversities and resources; however, no interactions were observed. Hill, et al. (Hill *et al.*, 2010), found partial evidence for mediation and moderation of childhood adversities and mental distress via social support, suggesting the importance of different domains of social support. They observed that instrumental social support (i.e. tangible help received from the social network) operated as a mediator, but not as a moderator; whereas emotional support, operated as a moderator, but not as a mediator (Hill *et al.*, 2010). In line with previous studies, our results provide evidence for the possible effect of social support on mental health outcomes in later-life for individuals who have experienced childhood psychosocial adversity.

These findings align with Pearlin's stress process (1981) and Rutter's chains of risk (1987) theory, suggesting that participants who experience greater adversity may not be able to invoke the same resources available to individuals with lesser adversity. Previous research has demonstrated employment status and education are associated lower mental distress in adulthood and the relationship between childhood adversities and mental distress is mediated by these resources in a Japanese sample (Oshio *et al.*, 2013). In the current study education but not occupation-based socioeconomic position was identified as a mediator independently of other individual and social resources considered, and we did not consider employment status. Similar to Hatch, et al. (2007), we observed that participants with lower cognition and self-organisation experienced poorer late-life mental health, but in addition to these findings we also observed that these resources mediated the relationship between early-life psychosocial adversity and later-life mental health. Levels of social support and neighbourhood cohesion were lower among those with more childhood psychosocial adversity and were also identified as mediators. Social support has previously been shown to influence mental health outcomes resulting from stressors by encouraging positive psychological dispositions and promoting coping strategies,(Thoits, 1995) suggesting possible underlying mechanisms for the mediation observed in this analysis.

Clinical Implications

The importance of social support in life course mental health presents opportunities for interventions that foster greater resilience in later life. This is a particularly important finding given the tendency for social spheres to diminish as one ages. A recent systematic review of interventions for addressing social isolation suggests that theory-driven interventions that focus on engagement in a social activity within a group context were the most effective means of reducing isolation (Dickens *et al.*, 2011). At a policy level, it may be possible to facilitate greater interaction for adults through increased funding to venues that foster greater group interaction and networking. The observation that neighbourhood cohesion may play a role in positive mental health outcomes may provide an opportunity to promote greater resilience through both social intervention as well as environmental intervention, thus providing a several

different approaches. For example, long-term care facilities that encourage residents' active engagement through purpose-built architecture or programs, such as dancing, that promote socialisation may promote greater social support (Chrysikou *et al.*, 2016). However, in order to assess the degree to which these findings can be meaningfully applied and have meaningful clinical impact, further research is required to assess the causal relationship between these variables.

Strengths and Limitations

In utilising three waves of GHQ-28 scores captured over a 15-year period, we were able to provide a more accurate representative, longitudinal perspective of participants' mental health in the second half of life than would be possible with single observations of mental health. Repeat measures were also used for social support and physical activity, a further strength of these analyses. The present study benefits from the consideration of several psychosocial adversities experienced in childhood. Five of these were prospectively collected; however three were retrospectively collected. The recollection of maltreatment and affectionless control by mother or father may be subject to recall bias. Those with missing data on maltreatment and affectionless control were included in analysis if they had at least four complete childhood psychosocial adversity items. Previous analysis has shown that these retrospective measures show expected associations with other childhood psychosocial adversities such as parental divorce (Rodgers, 1996a). Further, data for childhood cognition and self-organisation were collected during childhood, which had temporal overlap with childhood psychosocial adversities. Nevertheless, it seems unlikely that lower childhood cognition or self-organisation would be key determinants of the psychosocial adversities considered here. The analytical sample was subject to missingness due to the requirement of participants to have GHQ-28 scores and at least four childhood adversities. The stipulations for inclusion resulted in substantial missingness for adversities (32.4%); neighbourhood cohesion also demonstrated high levels of missingness (35.1%). Participants missing from the sample had a lower socioeconomic position and had fewer resources, suggesting that a healthy survivor bias may exist in these analyses, which may limit the generalisability of these findings.

The current study examined the role of individual and social resources in the well-documented association between childhood psychosocial adversity and later life mental distress. Although many resources played roles in this relationship, social support demonstrated the strongest links with mental health resilience, through the mediation of adversity and mental distress. These results suggest that interventions to promote greater social support may be an effective means of offsetting psychosocial adversities experienced in childhood and fostering better mental health in older adults.

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Data used in this publication are available to bona fide researchers upon request to the NSHD Data Sharing Committee via a standard application procedure. Further details can be found at http://www.nshd.mrc.ac.uk/data (doi: 10.5522/NSHD/Q101; doi: 10.5522/NSHD/Q102).

Conflict of Interest:

All authors declare no conflict of interest.

Author Contributions:

TDC conducted the analysis and wrote the first draft. MR assisted in the analysis and interpretation. All authors contributed to and edited the final draft of the manuscript.

TDC had full access to all the data and had final responsibility for the decision to submit.

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Table 1: Data collection details for components of the cumulative psychosocial adversity score

Indicator	Description	Age collected	Categories	Prevalence (%)
Maltreatment	Participants asked, “As a child do you feel you were mistreated by your parents in any way?”	43 years	Yes or No	6.4
Low parental concern for their child’s education	Information on visiting teachers and headmasters for conferences, attending parent teacher association meetings derived from interviews with mothers and from information from school records	8, 11, 13 years	Little interest vs. average to very interested	15.8
Parental Psychiatric history	Mother’s asked if they or their partner had a psychiatric illness during the first 15 years of their child’s life	0-15 years	Present vs. not present	2.2
Parental divorce	Experience of parental divorce	0-16 years	Divorced vs. not divorced	6.1

Mother affectionless control	Based on the PBI26. The PBI measured participants' (at age 43 y) retrospective perceptions of their parents' style of affection and attachment to them before the age of 16 y. To define affectionless control the following cut-points were used: mothers care score of <27.0 and overprotection score of >13.5; and for fathers care score of <24.0 and overprotection score of >12.5.	43 years	Affectionless control vs. not affectionless control parenting	30.5
Father affectionless control	As above	As above	As above	30.5
Parent death	Experience of parental death	0-16 years	Death of any parent vs. both parents still alive at 16 years	5.9
Maternal separation	Longest time separated from mother	0-6 years	Separation vs. no separation	5.9

Table 2: Characteristics of the MRC NSHD (sample restricted to those with data on GHQ-28 at 53, 60-64, or 68-69 and at least 4 complete childhood adversity variables)

			% or mean(SD)	% Missing	n
		Men	49.37%	0.00%	1375
		Women	50.63%	0.00%	1410
Mental Health	GHQ-28	Age 53	45.21 (9.44)	0.00%	2785
		Age 60-64	44.31 (8.14)		2215
		Age 68-69	43.05 (7.92)		1630
Adversities	Psychosocial	0 adversities	44.42%	32.42%	836
		1 adversity	28.43%		535
		2 adversities	20.14%		379
		3 or more adversities	7.01%		132
Socioeconomic Indicators	Education	None/Sub-GCE	42.57%	4.60%	1131
		O-level	20.62%		548
		A level or equivalent	26.42%		702
		Degree or higher	10.39%		276
	Occupational Status	V Unskilled	3.58%	0.83%	99
		IV Partly skilled	8.65%		239
		IIM Skilled (Manual)	25.02%		691
		IIINM Skilled (Non-manual)	12.13%		335
		II Intermediate	40.08%		1107
		I Professional	10.54%		291

Physical Activity (in past four weeks)	Age 53	No (0)	48.95%	0.54%	1356
		Yes, 1-4 times/month (1)	17.69%		490
		Yes, 5 or more times/month (2)	33.36%		924
	Age 60-64	No (0)	63.28%	4.83%	1334
		Yes, 1-4 times/month (1)	13.80%		291
		Yes, 5 or more times/month (2)	22.91%		483
	Age 68-69	No (0)	55.80%	6.32%	852
		Yes, 1-4 times/month (1)	13.75%		210
		Yes, 5 or more times/month (2)	30.45%		465
Social Support	Age 53		0.00(1.00)	8.29%	2554
	Age 60-64		0.01(1.00)	9.48%	2005
	Age 68-69		0.00(0.99)	0.00%	1630
Neighbourhood Cohesion	Age 60-64		0.01(1.00)	35.08%	1808

Table 3: Ordinal logistic, multinomial logistic, and linear sex-adjusted regression models of the relationship between childhood psychosocial adversity scores (exposure) and resources (outcome)

Domain	Resource (outcome)		Age(s) Measured	Likelihood of Having the Resource per Unit Increase in Childhood Adversity		
				OR	95% CI	
Individual	Physical Activity[a]		53, 60-64, 68-69	0.964	0.840	1.107
				RRR	95% CI	
	Occupational Status	V Unskilled	53	Referent		
		IV Partly skilled		0.917	0.747	1.124
		IIM Skilled (Manual)		0.977	0.685	1.394
		IIINM Skilled (Non-manual)		0.943	0.565	1.574
		II Intermediate		0.840	0.638	1.106
		I Professional		0.866	0.548	1.370
	Education	None/Sub-GCE	53	Referent		
		O-level		0.833	0.777	0.893
		A level or equivalent		0.861	0.790	0.939
		Degree or higher		0.782	0.689	0.888
				β	95% CI	
Social	Social Support		53, 60-64, 68-69	-0.115	-0.141	-0.090

Neighbourhood Cohesion	60-64	-0.120	-0.145	-0.094

Based on imputed data in sample restricted to those with data on GHQ-28 at 53, 60-64, or 68-69 and at least 4 complete childhood adversity variables, n=2785 participants. OR: Odds ratio; RRR: Relative risk ratio; [a] Based on linear multilevel regression with the outcome leisure time physical activities in the past four weeks coded as No (0), Yes, 1-4 times/month (1), Yes, 5 or more times/month (2)

Table 4: Linear multilevel regression of individual and social resources (exposure) and log-transformed GHQ-28 score (outcome)

		Sex-adjusted			Fully-adjusted[a]		
		β[e]	95% Confidence Interval		β	95% Confidence Interval	
Domain	Resource (exposure)						
Individual	Physical Activity[b]	-0.011	-0.0157	-0.0067	-0.009	-0.014	-0.005
	Occupational Status[c]	-0.008	-0.0124	-0.0041	-0.002	-0.007	0.003
	Education[d]	-0.009	-0.0148	-0.0038	0.004	-0.004	0.012
Social	Social Support	-0.034	-0.0386	-0.0301	-0.033	-0.037	-0.028
	Neighbourhood Cohesion	-0.019	-0.0393	0.0003	-0.013	-0.035	0.009

[a] Adjusted for physical activity, occupational status, education, childhood cognition, self-organisation, social support, neighbourhood cohesion; [b]Leisure time physical activities in the past four weeks coded as No (0), Yes, 1-4 times/month (1), Yes, 5 or more times/month (2); [c] Occupational status coded as V Unskilled (1), IV Partly skilled (2), IIM Skilled (Manual)(3), IIINM Skilled (Non-manual) (4), II Intermediate (5), I Professional (6); [d] None/Sub-GCE (1), O-level (2), A level or equivalent (3), Degree or higher (4); [e] Average change in GHQ-28 score per unit increase in resource score

Table 5: Mediation analysis[a] of log-transformed GHQ-28 score and childhood psychosocial adversity by individual and social resources

		β	% Mediated
Sex-adjusted (model m0)		0.017	
Adjusted for (model m1)			
Individual Resources	Physical Activity	0.016	7.10%
	Occupational Status	0.016	8.60%
	Education	0.016	9.48%
Social Resources	Social Support	0.013	25.25%
	Neighbourhood Cohesion	0.015	16.14%
All resources (model m2)		0.011	39.52%

[a]Percentage change in psychosocial adversity regression coefficient from i) sex-adjusted model and ii) sex and resource-adjusted model.

Supplementary Table 1: Social support index

Survey Question	Response (Score)
How much in the last 12 months did you confide in the person you felt closest to?	A great deal (10) Quite a lot (6.7) A little (3.3) Not at all (0)
How much in the last 12 months would you have liked to have confided more in the person you felt closest to?	A great deal (0) Quite a lot (3.3) A little (6.7) Not at all (10)
How much, in the last 12 months, did you share interests, hobbies?	A great deal (10) Quite a lot (6.7) A little (3.3) Not at all (0)
How much, in the last 12 months, did the person you felt closest to give you worries, problems and stress?	A great deal (0) Quite a lot (3.3) A little (6.7) Not at all (10)
How much in the last 12 months did talking to the person you feel closest to make things worse?	A great deal (0) Quite a lot (3.3) A little (6.7) Not at all (10)
How much in the last 12 months did talking to the person you feel closest to make you feel good about yourself?	A great deal (10) Quite a lot (6.7)

A little (3.3)
Not at all (0)

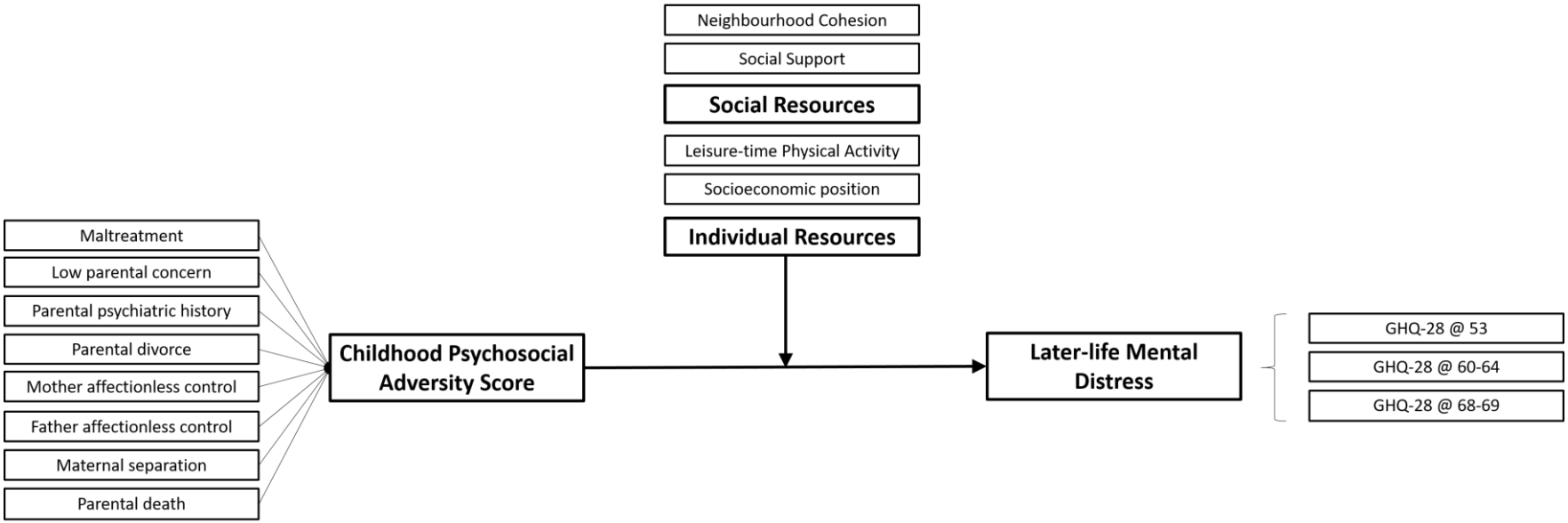
Supplementary Table 2: Odds of being excluded from the sample, i.e. missing due to no GHQ score or more than three missing adversities, by demographic variable and resource

	Sex-adjusted OR	95% Confidence Interval	
Female (reference male)	0.74	0.66	0.82
Physical Activity	0.79	0.66	0.95
Occupational Status	0.89	0.84	0.95
Education	0.82	0.77	0.87
Childhood Cognition	0.83	0.77	0.89
Self-Organisation	0.79	0.74	0.85
Social Support	0.98	0.80	1.20
Neighbourhood Cohesion	0.86	0.74	1.00

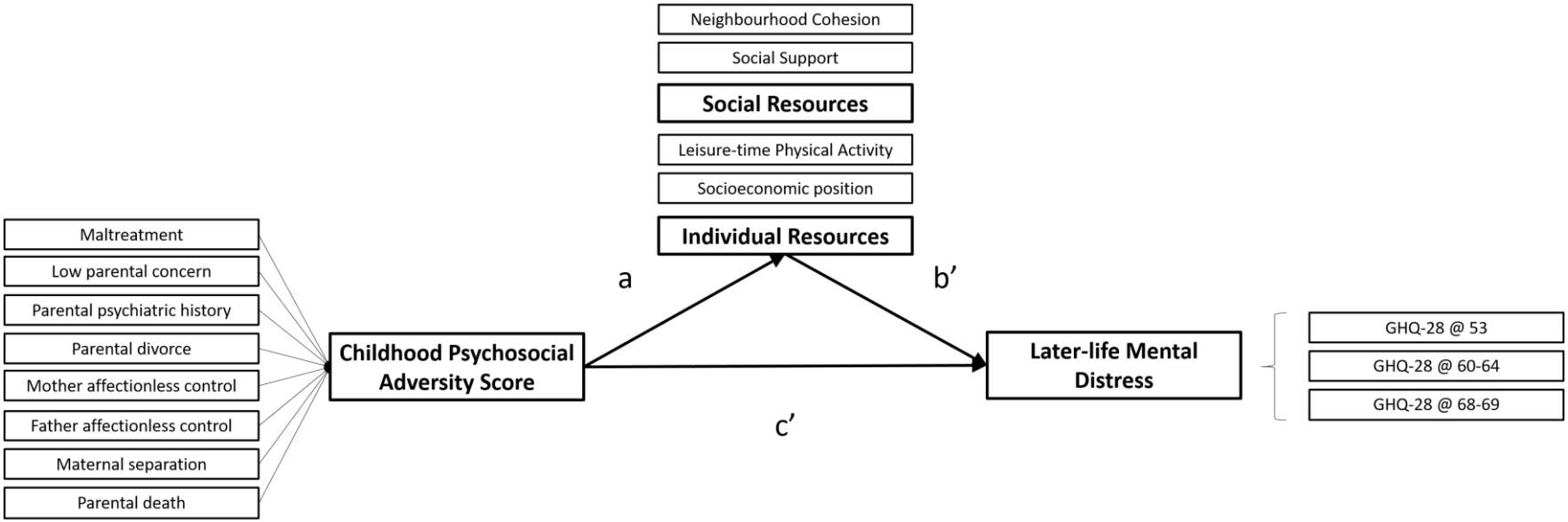
OR: Odds ratio

Supplementary Table 3: Linear multilevel regression of log-transformed GHQ-28 scores on individual components of the childhood psychosocial adversity score

n	Sex-adjusted β	95% Confidence Interval	
Maltreatment	0.045	0.021	0.068
Low parental concern for their child's education	0.026	0.008	0.044
Parental psychiatric history	0.025	-0.013	0.063
Parental divorce	0.032	0.008	0.056
Mother affectionless control	0.022	0.010	0.034
Father affectionless control	0.037	0.025	0.049
Parent death	0.003	-0.019	0.025
Maternal separation	0.010	-0.016	0.035



Supplementary Figure 1: Directed acyclic graph of the moderation of childhood psychosocial adversity score and later-life mental distress (at ages 53, 60-64, and 68-69) by individual and social resources



Supplementary Figure 2: Directed acyclic graph of the mediation of childhood psychosocial adversity score and later-life mental distress (at ages 53, 60-64, and 68-69) by individual and social resources

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